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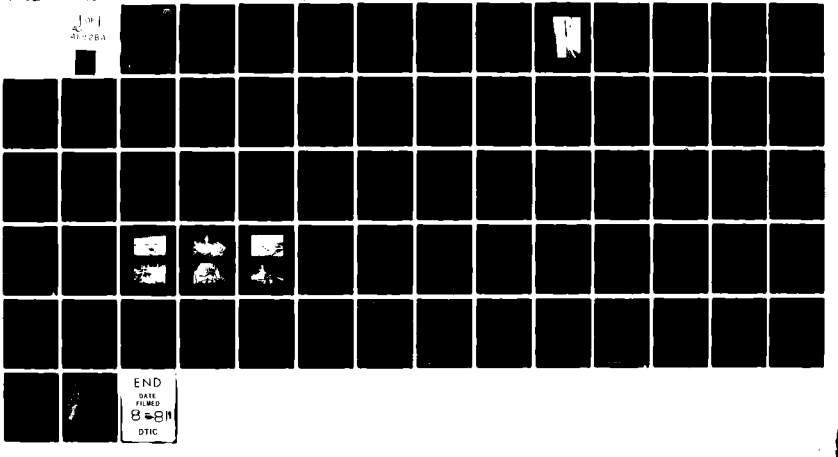

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DELAWARE RIVER BASIN

LAKEVILLE CREEK, WAYNE COUNTY

PENNSYLVANIA

LEVEL II

AD A101284

LAKE PAUPACKAN DAM

NDI ID NO. PA-00140
DER ID NO. 64-33

PAUPACKAN LAKE ESTATES

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

"Original contains color plates: All DTIC reproductions will be in black and white"

Prepared by
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Consulting Engineers
Harrisburg, Pennsylvania 17105

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For
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

MARCH 1981

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DELAWARE RIVER BASIN

LAKEVILLE CREEK, WAYNE COUNTY

PENNSYLVANIA

LAKE PAUPACKAN DAM

NDI ID No. PA-00140
DER ID No. 64-33

PAUPACKAN LAKE ESTATES

(6) National Dam Inspection Program. Lake Paupackan Dam (NDI ID Number PA-ØØ14Ø, DER ID Number 64-33), Delaware River Basin, Lakeville, Creek, Wayne County, Pennsylvania. Phase I Inspection Report.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

(10) 71

Prepared by

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
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P.O. Box 1963
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Contract DACW31-81-C-0018
(15) For

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

(11) MARCH 1981

AD A117004

PREFACE

This report is prepared under guidance contained in Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

LAKE PAUPACKAN DAM

NDI ID No. PA-00140; DER ID No. 64-33

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

CONTENTS

APPENDICES

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam:	Lake Paupackan Dam NDI ID No. PA-00140 DER ID No. 64-33
Size:	Intermediate (11 feet high; 1,188 acre-feet)
Hazard Classification:	Significant
Owner:	Paupackan Lake Estates P.O. Box 60 Lakeville, PA 18438 Attention: Mr. Jim Birmingham
State Located:	Pennsylvania
County Located:	Wayne
Stream:	Lakeville Creek
Date of Inspection:	11 November 1980

Based on available records, visual inspection, calculations, and past operational performance, Lake Paupackan Dam is judged to be in fair condition. Considering the size and hazard classification of the dam, the recommended Spillway Design Flood (SDF) varies between the 1/2 Probable Maximum Flood (PMF) and the PMF. The 1/2 PMF was, in this case, selected as the SDF. The spillway and reservoir, under existing conditions, will pass approximately 19 percent of the PMF before overtopping of the dam occurs. The spillway is, therefore, rated as inadequate.

No obvious stability problems were observed at the dam. However, the downstream slope and toe of the dam were covered with uncompacted earth and debris and could not be inspected. There are a number of conditions at the dam

which could rapidly develop into stability problems if allowed to go unchecked. Overall, maintenance of the dam has been inadequate.

The following studies and remedial measures, listed in approximate order of priority, are recommended to be undertaken by the Owner without delay.

(1) Remove all debris, brush, and trees from the top of dam, downstream slope, and toe of the dam; and then perform an inspection of these areas. This inspection should include a close examination of the seepage described in this report. As a minimum, the seepage should be visually monitored. If a change in the seepage occurs or if any other deficiencies are noted during the inspection, take appropriate action as required.

(2) Perform additional studies to more accurately ascertain the spillway capacity required for Lake Paupackan Dam and develop alternatives to provide adequate spillway capacity. Take appropriate action as required.

(3) Perform additional studies to determine the extent of measures required to repair or reconstruct the existing spillway. This may be completed in conjunction with recommendation (2) above.

(4) Determine the ability of the outlet works to draw down the reservoir to an appropriate level. If the existing outlet works cannot draw the pool down, develop a suitable means of drawing down the reservoir in case of an emergency. Any pipe that is placed through the embankment should be provided with an upstream closure facility.

(5) Repair the eroded and sloughed areas on the upstream slope and provide adequate erosion protection.

All investigations, studies, designs, and inspection of construction should be performed by a professional engineer experienced in the design and construction of dams.

In addition, the Owner should institute the following operational and maintenance procedures:

(1) Develop a detailed emergency operation and warning system for Lake Paupackan Dam. When warnings of a major storm are given by the National Weather Service, the Owner should activate the emergency operation and warning system.

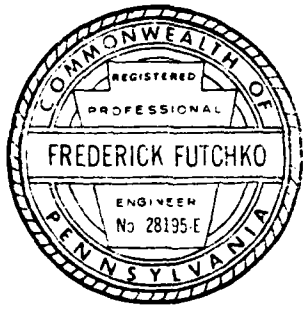
(2) During periods of unusually heavy rains, provide round-the-clock surveillance of the dam.

(3) Initiate an inspection program such that the dam is inspected on a regular basis. As presently required by the Commonwealth, the inspection program should include a formal annual inspection by a professional engineer experienced in the design and construction of dams. Utilize the inspection results to determine if remedial measures are necessary.

(4) Institute a maintenance program and develop a formal maintenance manual so that all features of the dam are properly maintained.

LAKE PAUPACKAN DAM

Submitted by:



GANNETT FLEMING CORDDRY
AND CARPENTER, INC.

Frederick Futchko

FREDERICK FUTCHKO
Project Manager, Dam Section

Date: 13 April 1981

Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF
ENGINEERS

James W. Peck

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Date: 11 MAY 81

LAKE PAUPACKAN DAM

Overview

LAKE PAUPACKAN DAM

NDI ID No. PA-00140; DER ID No. 64-33

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

SECTION 1

PROJECT INFORMATION

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Lake Paupackan Dam (formerly Long Pond Dam) is an earthfill structure of varying cross-section. The dam is approximately 390 feet long and 11 feet high. An asphalt roadway is located on the top of the dam which provides access to Paupackan Lake Estates. The top of dam width varies from about 15 to 23 feet.

The spillway consists of a 13-foot wide concrete weir which discharges into 36- and 48-inch corrugated metal pipes (CMP). The 36-inch CMP has a 2-foot high by 4-foot wide concrete entrance. Both pipes are 32 feet long and discharge into the stream channel at the toe of the dam.

The outlet works valve chamber is located on the right side of the spillway entrance. Two 16-inch steel pipes exit the chamber at the toe of the spillway weir. The other features of the outlet works could not be determined during the inspection.

The various features of the dam are shown on the photographs in Appendix C, Exhibit B-1, and Plate E-2. A description of the geology is included in Appendix F.

b. Location. Lake Paupackan Dam is located on Lakeville Creek approximately 2.2 miles upstream of Lake Wallenpaupack and 1.3 miles northwest of Lakeville in Paupack Township, Wayne County, Pennsylvania. The dam is located on USGS quadrangle Lakeville, Pennsylvania at latitude N 41° 27.3' and longitude W 75° 17.4'. A location map is shown on Plate E-1.

c. Size Classification. Intermediate (11 feet high, 1,188 acre-feet).

d. Hazard Classification. Downstream conditions indicate that a significant hazard classification is warranted for Lake Paupackan Dam (Paragraphs 3.1e and 5.1c).

e. Ownership. Paupackan Lake Estates, P.O. Box 60, Lakeville, PA 18438, Attn: Mr. Jim Birmingham.

f. Purpose of Dam. Recreation.

g. Design and Construction History. Lake Paupackan Dam was constructed sometime prior to 1914. The dam is situated several hundred feet downstream from the outlet of a natural pond which existed prior to constructing the dam. The "Survey of Lakes" conducted in 1914 by the Pennsylvania Water Supply Commission (PWSC) indicated that the dam was an earthfill structure approximately 200 feet long, 5 feet high, and had a top of dam width of 18 feet. A report dated 1919, also by the PWSC, stated that the dam had dry stone masonry walls on the upstream and downstream sides of the dam. A number of modifications were made to the dam during the following years, none of which are very well documented. Modifications apparently made to the dam during the period 1919 to date include:

(1) Addition of an earthfill section on the upstream side of the dam. It is unknown whether or not the stone masonry wall was removed prior to constructing the existing slope.

(2) Reconstruction of the spillway.

(3) Raising of the dam. The dam was reportedly raised 2 to 4 feet sometime between 1959 and 1962.

Numerous minor repairs and possibly other modifications have also been made to the dam during its operational history.

h. Normal Operational Procedures. Inflows to the reservoir are discharged over the spillway weir and through the 36- and 48-inch pipes. There is no established procedure for operation of the outlet works facilities.

1.3 Pertinent Data.

a. Drainage Area. (square miles)	2.62
b. Discharge at Damsite. (cfs)	
Maximum known flood	1955-discharge unknown
Outlet works	Unknown
Spillway (pool el. 1338.7)	283
c. Elevation. (feet above msl.)[1]	
Minimum Top of Dam	1338.7
Maximum Pool	1338.7
Normal Pool (Spillway Crest)	1337.0
Streambed at Toe of Dam	1327.4
d. Reservoir Length. (miles)	
Normal Pool	1.84
Maximum Pool	2.12
e. Storage. (acre-feet)[2]	
Normal Pool	765
Maximum Pool	1,188
f. Reservoir Surface. (acres)	
Normal Pool	239
Maximum Pool	261
g. Dam.	
Type	Earthfill
Length (feet)	390
Height (feet)	11
Top Width (feet)	Varies, 15 to 28
Side Slopes	
Upstream	Obscured by reservoir
Downstream	Obscured

[1]Elevations referenced to metal plate on top of valve chamber marked 1338 feet.

[2]Measured from streambed at toe of dam; does not include natural lake storage.

g.	Dam. (Cont'd)	
	Zoning	Unknown
	Cutoff	Unknown
	Grout Curtain	Unknown
	Drains	None
h.	Diversion and Regulating Tunnel	None
i.	Spillway.	
	Type	Concrete weir with 36- and 48-inch outlet pipes (CMP)
	Length (feet)	50±
	Base Width at Entrance (feet)	13
	Crest Elevation (feet msl.)	1337.0
	Gates	None
	Downstream Channel	Natural stream channel
j.	Regulating Outlets.	
	Type	Two 16-inch dia. steel pipes
	Inlet Invert Elevation (feet msl.)	Unknown
	Exit Invert Elevation (feet msl.)	1330.3
	Closure	Unknown

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. No design data are available for the dam or subsequent modifications.

b. Design Features. The various features of the dam are described in Paragraph 1.2a and are shown on the photographs in Appendix C and on Plate E-2 in Appendix E.

c. Design Considerations. The design of the dam cannot be assessed from available data.

2.2 Construction.

a. Data Available. There are no construction data available for Lake Paupackan Dam.

b. Construction Considerations. The construction of the dam cannot be assessed from available data.

2.3 Operation. There are no formal records of operation. A record of operation does exist in the form of inspections performed by the Commonwealth during the period from 1924 to 1965. A summary of the inspection reports is included in Appendix A.

2.4 Evaluation.

a. Availability. Limited engineering data were provided by the Bureau of Dams and Waterway Management, Department of Environmental Resources, Commonwealth of Pennsylvania (PennDER). The Owner's representative was not available for information during the visual inspection.

b. Adequacy. The type and amount of available design data and other engineering data are limited, and the assessment must, therefore, be based on the combination of available data, visual inspection, performance history, hydrologic and hydraulic assumptions, and calculations developed for this report.

c. Validity. There is no reason to question the validity of the available data.

SECTION 3

VISUAL INSPECTION

3.1 Findings.

a. General. The overall appearance of the dam and appurtenant structures is fair. Noteworthy deficiencies observed are described in the following paragraphs. The complete visual inspection checklist and sketch of the dam are presented in Appendix B. A profile of the top of the dam and typical cross-sections are included in Appendix E. On the day of the inspection, the reservoir pool was approximately 0.3 foot below the spillway crest.

b. Embankment. The downstream slope and toe of the embankment are covered with uncompacted earth, woody material and tree slashings. The slope and toe area could, therefore, not be inspected. The upper portion of the downstream slope, the downstream edge of the top of dam, and the toe of the dam are covered with brush and small trees up to 2 inches in diameter. The upstream slope of the embankment is eroded and sloughed along its entire length. Some rock was observed on the slope at the normal pool level which may have at one time formed the upstream face of the dam. The rock, however, affords very little protection against erosion. Seepage was observed exiting through the debris near the toe of the embankment approximately 40 feet left of the spillway and 25 feet from the downstream edge of the road. The seepage was clear and was estimated at 20 gallons per minute (gpm.)

c. Appurtenant Structures. The bottom of the lower spillway outlet pipe is completely disintegrated. Very little soil was observed along the bottom of the pipe, indicating that the finer soil particles may have been transported from the dam by water flowing along the pipe. However, no active transporting of fines was observed on the day of the inspection. One section of the upper spillway outlet pipe, approximately 8 feet from the entrance, was separated vertically approximately 1 to 2 inches. No intrusion of soil particles into the pipe was observed. The entrance to the lower outlet pipe was obstructed with debris. Some erosion of the concrete spillway weir and deterioration of the spillway entrance wall was also observed.

The overall condition of the outlet works facilities is unknown as the valve chamber was locked and, therefore, could not be inspected. The exit end of the outlet pipes were visible and were found to be somewhat corroded.

d. Reservoir Area. Lake Paupackan covers approximately 14 percent of the watershed area. Although the area along the western side of the lake is developed, most of the watershed is wooded and has no other reservoirs or ponds within its boundaries. The hills in the area rise to a maximum elevation of about 200 feet above the reservoir and are gently to moderately sloping. According to correspondence contained in the files of PennDER, a low area reportedly exists at the upper end of the watershed which would be overtopped during high reservoir stages. An inspection of this area, however, revealed no low area of this nature.

e. Downstream Channel. The stream valley between Lake Paupackan Dam and Locklin Pond is wooded and undeveloped. Locklin Pond is located approximately 1,500 feet downstream from the dam. Locklin Pond Dam, located about 1.3 miles downstream, is 13 feet high and impounds 448 acre-feet at maximum pool. It is estimated that failure of Lake Paupackan Dam could cause failure of Locklin Pond Dam and severe flooding of one residence located just downstream of Locklin Pond Dam. It is probable that few lives would be lost in the event of a failure of Lake Paupackan Dam.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure. Inflows to the reservoir are discharged through the spillway. There is no established procedure for operation of the outlet works.

4.2 Maintenance of Dam. Very little maintenance work has been performed in recent years. There are, apparently, no established maintenance procedures for the dam or appurtenant structures.

4.3 Maintenance of Operating Facilities. There are no established maintenance procedures for the outlet works facilities.

4.4 Warning Systems in Effect. There is no emergency operation and warning system in effect.

4.5 Evaluation of Operational Adequacy. The maintenance of the dam is inadequate. A program of formal annual inspections is necessary to detect potentially hazardous conditions at the dam. A detailed emergency operation and warning system is necessary to reduce the risk of dam failure should adverse conditions develop and to prevent loss of life should the dam fail.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features.

a. Design Data. No hydrologic or hydraulic design information is available for Lake Paupackan Dam.

b. Experience Data. The maximum recorded flood at the site occurred in August 1955 during which time the dam was overtopped by approximately one foot. The dam reportedly suffered no damage as a result of the overtopping.

c. Visual Observations.

(1) General. The visual inspection of Lake Paupackan Dam, which is described in Section 3, resulted in a number of observations relevant to hydrology and hydraulics.

(2) Embankment. The upstream slope of the embankment shows signs of erosion at the normal pool level. No localized low areas were observed on the top of the dam. The minimum top of dam elevation as determined during the field inspection is only 1.7 feet above the spillway crest.

(3) Appurtenant Structures. The concrete entrance to the 36-inch CMP was blocked with debris, which reduces the capacity of the spillway. For the purpose of the hydrologic and hydraulic analysis, however, the pipe was assumed to be unobstructed.

(4) Reservoir Area. As previously mentioned, the reservoir itself comprises about 14 percent of the watershed area. The watershed, which consists primarily of woods, contains no other lakes or impoundments.

(5) Downstream Conditions. Locklin Pond is located approximately 1,500 feet downstream from Lake Paupackan Dam. The physical characteristics and proximity of the two dams are such that failure of Lake Paupackan Dam could cause failure of Locklin Pond Dam and subsequent flooding of one permanent dwelling downstream. Therefore a "significant" hazard classification has been assigned to Lake Paupackan Dam.

d. Overtopping Potential.

(1) Spillway Design Flood. According to the criteria established by the Office of the Chief of Engineers (OCE), the Spillway Design Flood (SDF) for the size

(intermediate) and hazard potential (significant) of Lake Paupackan Dam is between the one-half Probable Maximum Flood (1/2 PMF) and the Probable Maximum Flood (PMF). Since the dam and reservoir are on the low end of the intermediate size category, the 1/2 PMF was selected as the SDF. The watershed and reservoir were modeled with the U. S. Army Corps of Engineers' HEC-1DB comuter program, a description of which is included in Appendix D. The hydrologic and hydraulic assessment of the dam is based on existing conditions; the effects of future development were not considered.

(2) Summary of Results. Pertinent results are tabulated at the end of Appendix D. The analysis reveals that Lake Paupackan Dam can pass only 19 percent of the PMF before overtopping of the dam occurs.

(3) Spillway Adequacy. The criteria used to evaluate the spillway adequacy are described in Appendix D. Because Lake Paupackan Dam cannot pass the 1/2 PMF, the spillway capacity of the dam is rated as inadequate.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations.

(1) General. The visual inspection of Lake Paupackan Dam, which is described in Section 3, resulted in a number of observations relevant to structural stability. These observations are evaluated herein for the various features.

(2) Embankment. As mentioned previously, the downstream slope and toe of the embankment were covered with uncompacted earth, tree slashings, and other woody material. Although this debris is not a structural hazard to the dam, it did hinder the visual inspection of the embankment and may have obscured structural deficiencies.

The eroded upstream slope is not, at the present time, a problem which seriously threatens the stability of the dam. It is, however, the type of problem which can lead to rapid deterioration of an earth dam if allowed to continue unchecked.

The seepage near the toe of the embankment is also the type of deficiency which can lead to rapid deterioration of an earth dam. However, since the point at which the seepage is exiting the embankment could not be observed, the degree to which the seepage is affecting the stability of the dam could not be ascertained.

(3) Appurtenant Structures. The disintegrated lower spillway pipe is considered a definite threat to the stability of the embankment. This condition will result in erosion and transport of soil particles from the interior of the embankment and eventual collapse of that portion of the dam. The separation in the 48-inch CMP is not, at the present time, considered a threat to the structural stability of the dam.

b. Design and Construction Data. There are no design or construction data for the dam or appurtenant structures.

c. Operating Records. There are no formal records of operation. Based on available information, no serious stability problems are known to have occurred during the operational history of the dam.

d. Post-construction Changes. The modifications and repairs made to the dam in the past have not had an adverse effect on the stability of the dam.

e. Seismic Stability. Lake Paupackan Dam is located in Seismic Zone 1. Normally, it can be considered that if a dam in this zone has adequate factors of safety under static loading conditions, it can be assumed safe for any expected earthquake loading. However, since a major portion of the embankment could not be inspected, the seismic stability of the dam cannot be assessed.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety.

(1) Based on available records, visual inspection, calculations, and past operational performance, Lake Paupackan Dam is judged to be in fair condition. Based on the size and hazard classification of the dam, the recommended SDF varies between the 1/2 PMF and the PMF. The 1/2 PMF was, in this case, selected as the SDF. The spillway and reservoir, under existing conditions, will pass approximately 19 percent of the PMF before overtopping of the dam occurs. The spillway is, therefore, rated as inadequate.

(2) No obvious stability problems were observed at the dam. However, the downstream slope and toe of the dam were covered with uncompacted earth and debris and could not be inspected. There are a number of conditions at the dam which could rapidly develop into stability problems if allowed to go unchecked.

(3) Maintenance of the dam is inadequate.

(4) A summary of the features and observed deficiencies is as follows:

Feature	Observed Deficiency
Embankment	Uncompacted earth and debris on downstream slope and toe; brush and small trees on downstream slope and top of dam; erosion and sloughing of upstream slope; seepage near toe.
Spillway	Lower spillway pipe disintegrated; upper spillway pipe separated at joint; entrance to lower pipe blocked with debris; erosion of weir and wing wall.
Outlet Works	Outlet pipes corroded (remainder of outlet works not inspected).

b. Adequacy of Information. The information available is such that an assessment of the condition of the dam can be inferred from the combination of available information, visual inspection, past performance, and computations performed as part of this study.

c. Urgency. The recommendations in Paragraph 7.2 should be implemented without delay.

d. Necessity for Further Investigations. In order to accomplish the remedial measures outlined in Paragraph 7.2, further investigations by the Owner will be required.

7.2 Recommendations and Remedial Measures.

a. The following studies and remedial measures, listed in approximate order of priority, are recommended to be undertaken by the Owner without delay:

(1) Remove all debris, brush, and trees from the top of dam, downstream slope, and toe of the dam; and then perform an inspection of these areas. This inspection should include a close examination of the seepage described in this report. As a minimum, the seepage should be visually monitored. If a change in the seepage occurs or if any other deficiencies are noted during the inspection, take appropriate action as required.

(2) Perform additional studies to more accurately ascertain the spillway capacity required for Lake Paupackan Dam as well as the nature and extent of measures required to provide adequate spillway capacity. Take appropriate action as required.

(3) Perform additional studies to determine the extent of measures required to repair or reconstruct the existing spillway. This may be completed in conjunction with recommendation (2) above.

(4) Determine the ability of the outlet works to draw down the reservoir to an appropriate level. If the existing outlet works cannot draw the pool down, develop a suitable means of drawing down the reservoir in case of an emergency. Any pipe that is placed through the embankment should be provided with an upstream closure facility.

(5) Repair the eroded and sloughed areas on the upstream slope and provide adequate erosion protection.

All investigations, studies, designs, and inspection of construction should be performed by a professional engineer experienced in the design and construction of dams.

b. In addition, the Owner should institute the following operational and maintenance procedures:

(1) Develop a detailed emergency operation and warning system for Lake Paupackan Dam. When warnings of a major storm are given by the National Weather Service, the Owner should activate the emergency operation and warning system.

(2) During periods of unusually heavy rains, provide round-the-clock surveillance of the dam.

(3) Initiate an inspection program such that the dam is inspected on a regular basis. As presently required by the Commonwealth, the inspection program should include a formal annual inspection by a professional engineer experienced in the design and construction of dams. Utilize the inspection results to determine if remedial measures are necessary.

(4) Institute a maintenance program and develop a formal maintenance manual so that all features of the dam are properly maintained.

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: Lake Paupackan Dam

NDI ID NO.: PA-00140 DER ID NO.: 64-33

Sheet 1 of 4

ITEM	REMARKS
AS-BUILT DRAWINGS	None available
REGIONAL VICINITY MAP	See Plate E-1 (Appendix E)
CONSTRUCTION HISTORY	Not available
TYPICAL SECTIONS OF DAM	See Plate E-2
OUTLETS: Plan Details Constraints Discharge Ratings	Discharge rating for spillway is included in Appendix D; no other detailed information is available.

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	None maintained at damsite.
DESIGN REPORTS	Report on Long Pond prepared by the Commonwealth in 1919 gives a brief description of the original structure.
GEOLOGY REPORTS	See Appendix F
DESIGN COMPUTATIONS: Hydrology and Hydraulics Dam Stability Seepage Studies	None
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	None
POSTCONSTRUCTION SURVEYS OF DAM	None

ENGINEERING DATA

ITEM	REMARKS
BORROW SOURCES	Unknown
MONITORING SYSTEMS	None
MODIFICATIONS	Brief descriptions of modifications performed during life of dam are included in files of PennDER.
HIGH POOL RECORDS	None maintained; maximum pool believed to have occurred August 1955 - water level one foot above dam.
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	None
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	None reported

ENGINEERING DATA

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	None
SPILLWAY: Plan Sections Details	See page D-7 (Appendix D)
OPERATING EQUIPMENT: Plans Details	None
PREVIOUS INSPECTIONS Dates Deficiencies	17 July 1924 - Overall condition, fair.
	31 July 1930 - Considerable leakage under the stone masonry forming the spillway; debris at spillway entrance; spillway reconstructed since 1924 inspection; originally was a natural lake ~30' deep.
	12 May 1931 - Considerable leakage under spillway masonry; debris at spillway entrance; 8" flashboards in spillway; general appearance - good.

ENGINEERING DATA

ITEM	REMARKS
PREVIOUS INSPECTIONS (CONTINUED)	18 April 1934 - Seepage at left end; some local settlement along crest; general appearance - fair.
	10 August 1938 - Seepage at left end; no further settlement on crest; general appearance - fair.
	23 June 1948 - No apparent seepage; general appearance - excellent.
	26 March 1952 - Small amount of seepage near spillway; spillway concrete deteriorating; general appearance - good.
	12 March 1965 - General appearance - OK.

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: Lake Paupackan Dam County: Wayne State: Pennsylvania

NDI ID No.: PA-00140 DER ID No.: 64-33

Type of Dam: Earthfill Hazard Category: Significant

Date(s) Inspection: 11 November 1980 Weather: Overcast, windy snow flurries Temperature: 30°F

Pool Elevation at Time of Inspection: 1336.7 ft. msl/Tailwater at Time of Inspection: 1328± ft. msl

Note: Elevations referenced to metal plate on top of valve chamber - elev. 1338 ft.

Inspection Personnel:

D.B. Wilson (GFCC)

R.E. Holderbaum (GFCC)

D.R. Ebersole (GFCC)

R.E. Holderbaum Recorder

EMBANKMENT

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	Asphalt road is located on crest of embankment.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	Uncompacted earth, woody material and tree slashings cover downstream slope and toe of dam.	Could not inspect toe area.
SLOUGHING OR EROSION: Embankment Slopes Abutment Slopes	Upstream slope - badly eroded along entire length, numerous sloughed areas.	Unconsolidated random fill and debris deposited on downstream slope - could not inspect.
CREST ALIGNMENT: Vertical Horizontal	No obvious problems observed.	See top of dam profile (Plate E-2, Appendix E)
RIPRAP FAILURES	Rock on upstream slope at water line may be remnants of masonry wall.	Affords very little protection against erosion. Adequate erosion protection should be provided.

EMBANKMENT

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT WITH: Abutment Spillway Other Features	No problems observed.	Rock outcrop at left abutment of dam.
ANY NOTICEABLE SEEPAGE	Seepage near toe of dam 40 feet left of ℄ of spillway and 25 feet from downstream edge of road.	Clear - approximately 20 gpm.
STAFF GAGE AND RECORDER	None	
DRAINS	None	
TREES AND BRUSH	small trees and brush are growing on downstream slope and toe of dam; some brush on upstream slope.	Should be removed periodically.

OUTLET WORKS

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Two - 16 inch pipes exiting valve chamber are corroded.	Operability of outlet works should be investigated.
INTAKE STRUCTURE	steel plate on top was locked in place - could not inspect.	
OUTLET STRUCTURE	Discharges into spillway.	
OUTLET CHANNEL	Spillway (see UNGATED SPILLWAY)	
EMERGENCY GATE	Unknown	

UNGATED SPILLWAY

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Eroded.	
APPROACH CHANNEL	Lake; unobstructed; some erosion at left end of concrete wall.	
DISCHARGE CHANNEL	Natural stream channel.	
BRIDGE AND PIERS	Road on crest of dam crosses over outlet pipes.	
LOWER OUTLET PIPE (36")	Bottom is completely deteriorated; possible loss of fines along pipe - rocks visible with little soil apparent.	Entrance to pipe is obstructed; outlet pipe should be replaced.

UNGATED SPILLWAY

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
UPPER OUTLET PIPE (48")	Joint 8 feet from upstream end is separated 1 to 2 inches.	Should be repaired.

INSTRUMENTATION

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	Metal plate on top of concrete valve chamber.	Elevation 1338 feet MSL.
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER		

DOWNSTREAM CHANNEL

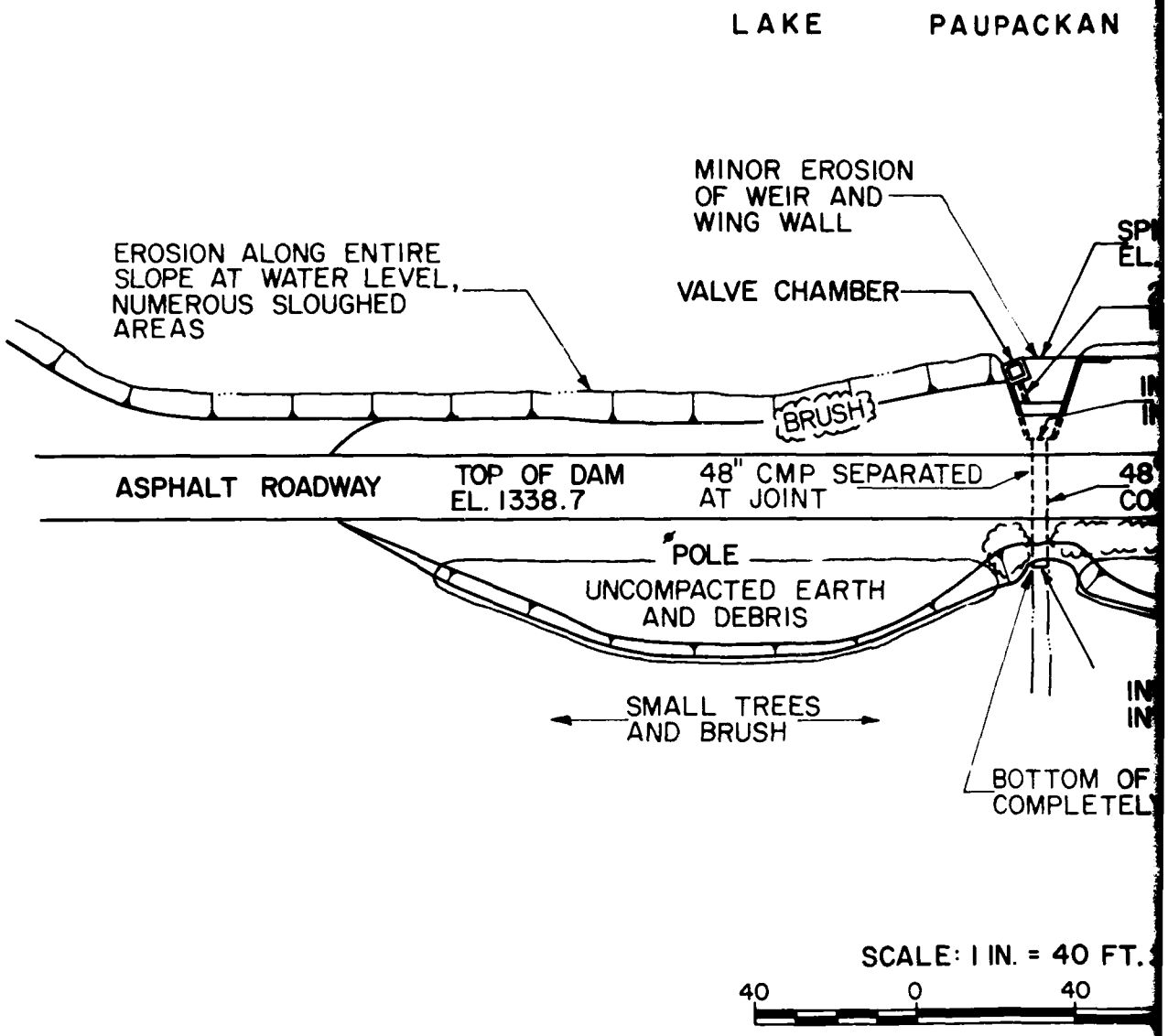
Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: Obstructions Debris Other	No major obstructions downstream to Locklin Pond; stream valley is wooded.	
SLOPES	Channel bed slope is approximately 4% between Lake Paupackan and Locklin Pond.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	Locklin Pond Dam located 1.3 miles downstream; one dwelling would be flooded to significant depth by failure of Locklin Pond Dam.	Locklin Pond Dam classified as "significant" hazard in previously completed Phase I report.

RESERVOIR AND WATERSHED

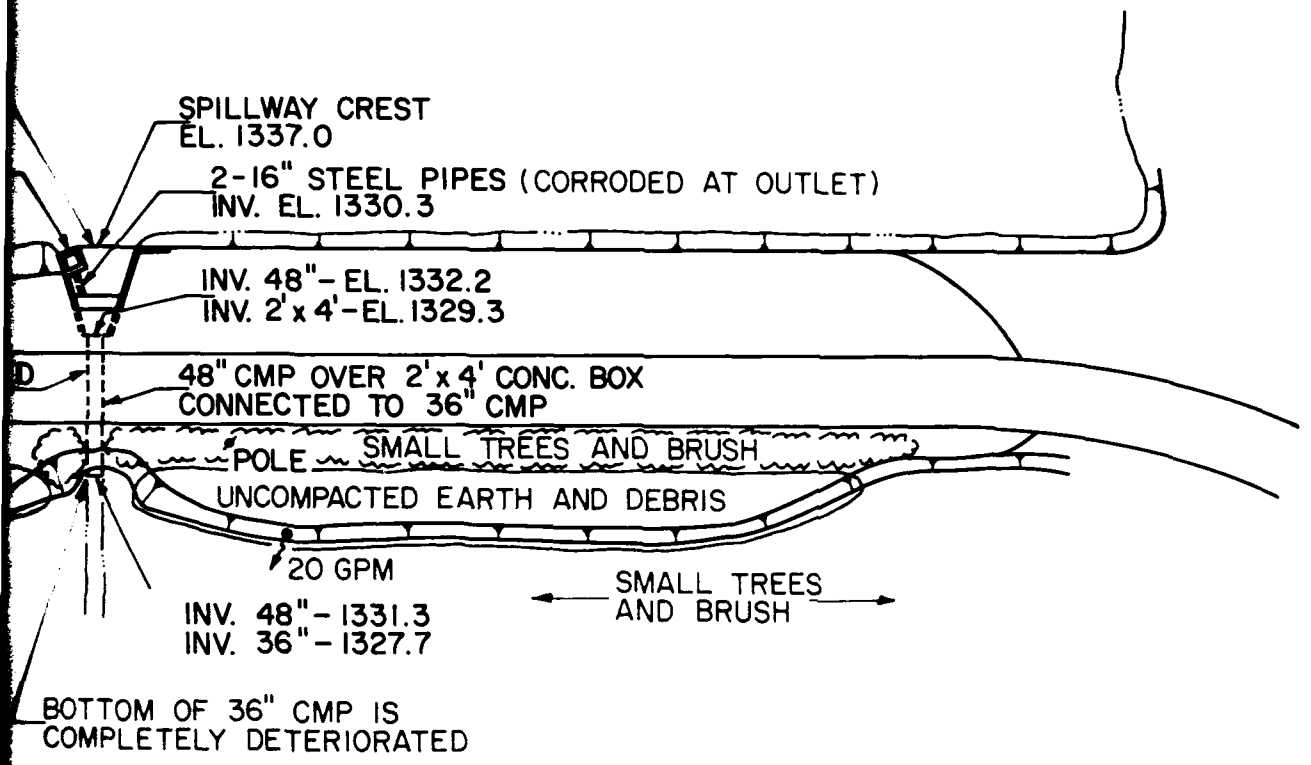
Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Moderately sloping; wooded.	
SEDIMENTATION	Unknown.	Probably minor considering nature of watershed.
WATERSHED DESCRIPTION	Primarily undeveloped; mostly wooded.	Lake surface covers 14 percent of watershed.



DATE OF INSPECTION: 11 NOVEMBER 1980
POOL ELEVATION: 1336.7 FEET

UPACKAN



1 IN. = 40 FT. ±

40 80

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE PAUPACKAN DAM

PAUPACKAN LAKE ESTATES

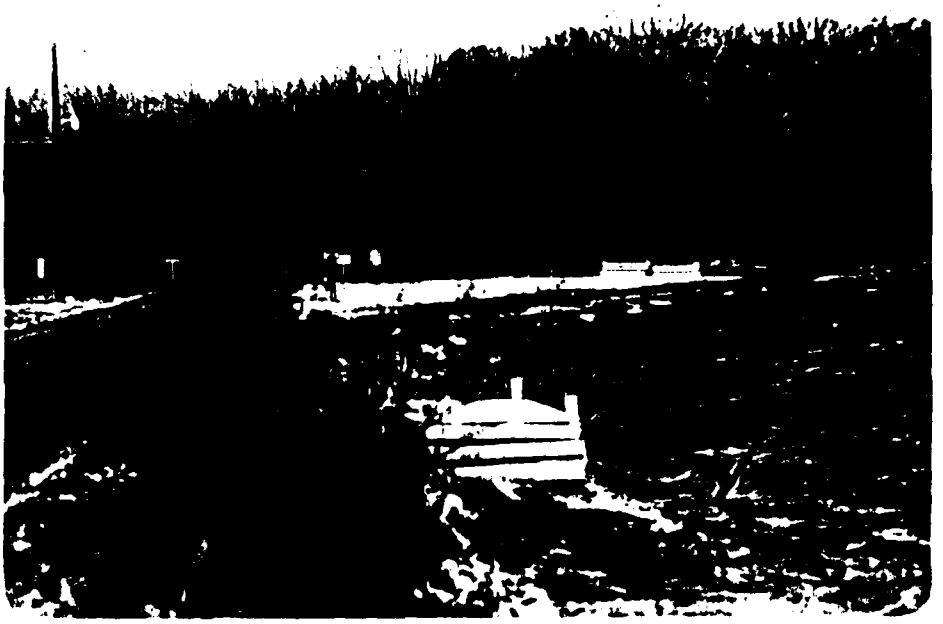
RESULTS OF
VISUAL INSPECTION

MARCH 1981 EXHIBIT B-1

APPENDIX C

PHOTOGRAPHS

LAKE PAUPACKAN DAM



A. Upstream Slope to Right of Spillway

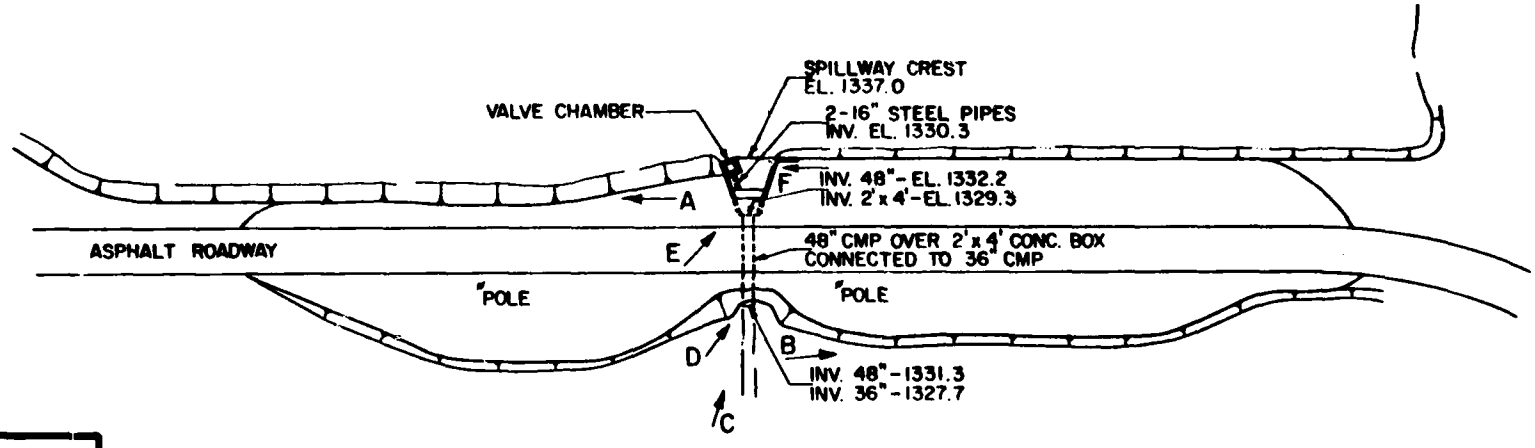
B. Downstream Slope and Toe

C. Exit End of Spillway Outlet Pipes

D. Lower Spillway Outlet Pipe

E. Spillway Entrance

F. Spillway Entrance and Upstream Slope



NOT TO SCALE

← LOCATION AND ORIENTATION OF CAMERA

A PHOTOGRAPH IDENTIFICATION LETTER

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE PAUPACKAN DAM

PAUPACKAN LAKE ESTATES

GUIDE TO LOCATION OF PHOTOGRAPHS

MARCH 1981

EXHIBIT C-1

APPENDIX D

HYDROLOGY AND HYDRAULICS

APPENDIX D

HYDROLOGY AND HYDRAULICS

Spillway Capacity Rating:

In the recommended Guidelines for Safety Inspection of Dams, the Department of the Army, Office of the Chief of Engineers (OCE), established criteria for rating the capacity of spillways. The recommended Spillway Design Flood (SDF) for the size (small, intermediate, or large) and hazard potential (low, significant, or high) classification of a dam is selected in accordance with the criteria. The SDF for those dams in the high hazard category varies between one-half of the Probable Maximum Flood (PMF) and the PMF. If the dam and spillway are not capable of passing the SDF without overtopping failure, the spillway capacity is rated as inadequate. If the dam and spillway are capable of passing one-half of the PMF without overtopping failure, or if the dam is not in the high hazard category, the spillway capacity is not rated as seriously inadequate. A spillway capacity is rated as seriously inadequate if all of the following conditions exist:

(a) There is a high hazard to loss of life from large flows downstream of the dam.

(b) Dam failure resulting from overtopping would significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure.

(c) The dam and spillway are not capable of passing one-half of the PMF without overtopping failure.

Description of Model:

If the Owner has not developed a PMF for the dam, the watershed is modeled with the HEC-1DB computer program, which was developed by the U.S. Army Corps of Engineers. The HEC-1DB computer program calculates a PMF runoff hydrograph (and percentages thereof) and routes the flows through both reservoirs and stream sections. In addition, it has the capability to simulate an overtopping dam failure. By modifying the rainfall criteria, it is also possible to model the 100-year flood with the program.

APPENDIX D

DELAWARE River Basin
Name of Stream: LAKEVILLE CREEK
Name of Dam: LAKE PAUPACKAN DAM
NDI ID No.: PA-00140
DER ID No.: 64-33
Latitude: N 41° 27.3' Longitude: W 75° 17.4'
Top of Dam Elevation: 1338.7 FEET
Streambed Elevation: 1327.4 ± Height of Dam: 11 ft
Reservoir Storage at Top of Dam Elevation: 1188 acre-ft
Size Category: INTERMEDIATE
Hazard Category: SIGNIFICANT (see Section 5)
Spillway Design Flood: 1/2 PMF TO PMF
USE 1/2 PMF (SEE SECTION 5)

UPSTREAM DAMS - NONE

Name	Distance from Dam (miles)	Height (ft)	Storage at top of Dam Elevation (acre-ft)	Remarks

DOWNSTREAM DAMS

LOCKLIN POND DAM	1.3	13	448	DER ID 64-31
LAKE WALLENPAUPACK	2.2 TO LAKE	66	214,800 AT NORMAL POOL	DER ID 52-51

DELAWARE River Basin

Name of Stream: LAKEVILLE CREEK

Name of Dam: PAUPACKAN LAKE DAM

DETERMINATION OF PMF RAINFALL & UNIT HYDROGRAPH

UNIT HYDROGRAPH DATA: (SEE NOTE BELOW)

Sub-area	Drainage Area (square miles)	Cp (1)	Ct (2)	L miles (3)	L_{ca} miles (4)	L' miles (5)	Tp hours (6)	Map Area (7)	Plate (8)
A-1	2.6	0.45	1.23	3.26	1.12	N/A	1.81	1	A
Total	2.6								

(See Sketch on Sheet D-4)

(1) & (2): Snyder Unit Hydrograph coefficients supplied by Baltimore District, Corps of Engineers on maps and plates referenced in (7) & (8)

The following are measured from the outlet of the subarea:

(3): Length of main watercourse extended to divide

(4): Length of main watercourse to the centroid

The following is measured from the upstream end of the reservoir at normal pool:

(5): Length of main watercourse extended to divide

(6): $Tp=C_t \times (L \times L_{ca})^{0.3}$, except where the centroid of the subarea is located in the reservoir. Then $Tp=C_t \times (L')^{0.6}$

Initial flow is assumed at 1.5 cfs/sq. mile

Computer Data: QRCSN = -0.05 (5% of peak flow)
RTIOR = 2.0

RAINFALL DATA:

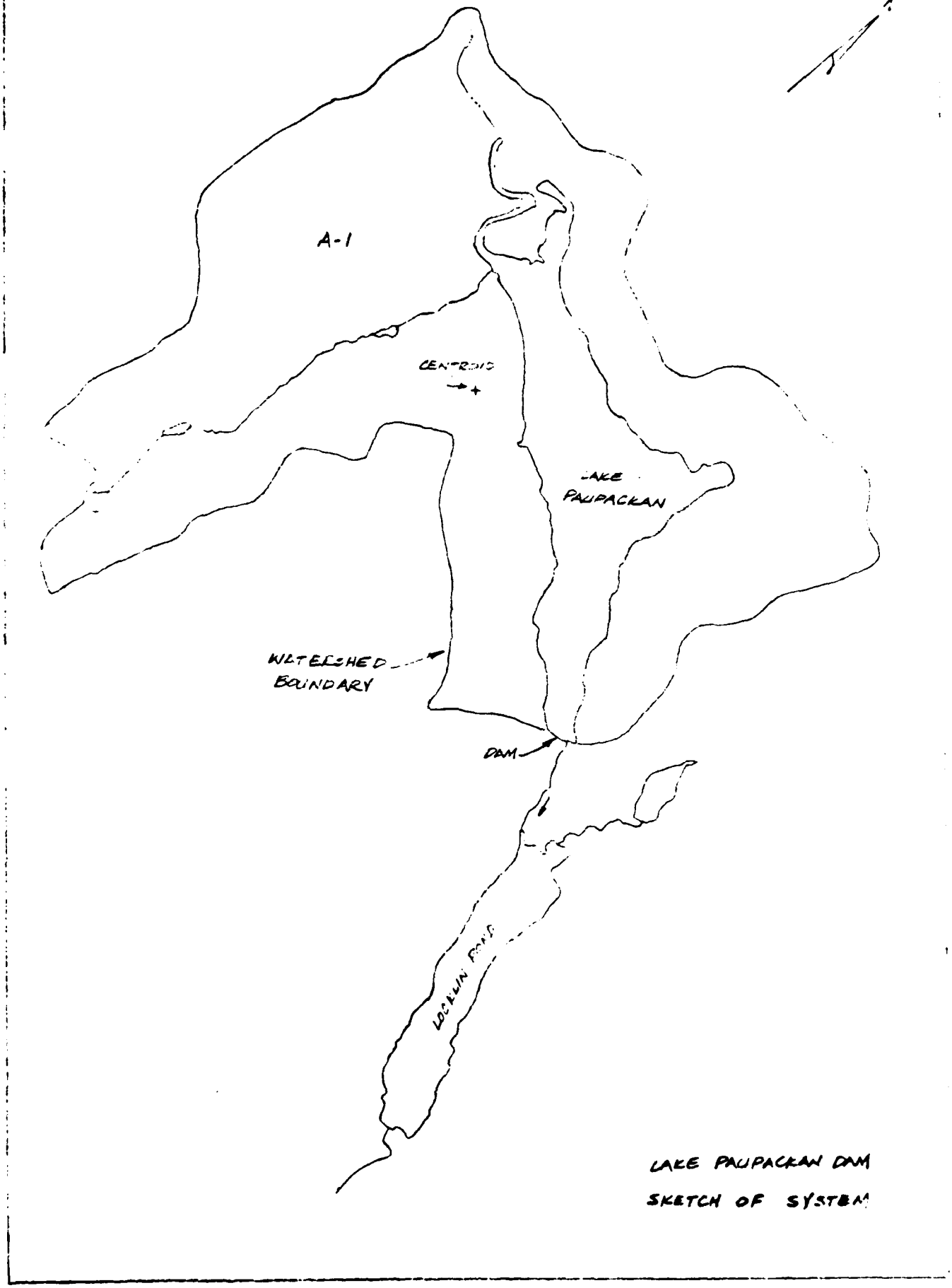
PMF Rainfall Index= 21.5 in., 24 hr., 200 sq. mile

	Hydromet. 40 (Susquehanna Basin)	Hydromet. 33 (Other Basins)
Zone:	N/A	/
Geographic Adjustment Factor:		1.0
Revised Index Rainfall:		21.5

RAINFALL DISTRIBUTION (percent)

Time	Percent
6 hours	111
12 hours	123
24 hours	133
48 hours	142
72 hours	N/A
96 hours	N/A

NOTE: UNIT HYDROGRAPH DATA WAS TAKEN FROM THE PHASE I REPORT FOR LOCKLIN POND DAM.



LAKE PAUPACKAN DAM
SKETCH OF SYSTEM

Data for Dam at Outlet of Subarea A-1 (See sketch on Sheet D-4)

Name of Dam: LAKE PAUPACKAN DAM

STORAGE DATA:

Elevation		Area (acres)		Storage million gals	Storage acre-ft		Remarks
1327.4	=ELEVO	0		0	0		STREAMBED AT TOE
1337.0	=ELEV1	239	=A1		765	=S1	NORMAL POOL
1338.7					1188		TOP OF DAM
1346.0		353					ESTIMATED (USGS QUAD)

Reservoir Area at Normal Pool is 14 percent of subarea watershed.

BREACH DATA: NO BREACH ANALYSIS REQUIRED

See Appendix B for sections and existing profile of the dam.

Soil Type from Visual Inspection: _____

Maximum Permissible Velocity (Plate 28, EM 1110-2-1601) _____ fps
(from $Q = CLH^{3/2} = V \cdot A$ and depth = (2/3) x H) & A = L·depth

HMAX = $(4/9\ V^2/C^2)$ = _____ ft., C = ____ Top of Dam El.= ____

HMAX + Top of Dam El. = _____ = FAILEL
(Above is elevation at which failure would start)

Dam Breach Data:

BRWID = _____ ft (width of bottom of breach)
Z = _____ (side slopes of breach)
ELBM = _____ (bottom of breach elevation, minimum of zero storage elevation)
WSEL = _____ (normal pool elevation)
T FAIL= _____ mins = _____ hrs (time for breach to develop)

Data for Dam at Outlet of Subarea A-1

Name of Dam: PAUPACKAN LAKE DAM

SPILLWAY DATA: SEE NEXT TWO SHEETS	Existing Conditions	Design Conditions
Top of Dam Elevation		
Spillway Crest Elevation		
Spillway Head Available (ft)		
Type Spillway		
"C" Value - Spillway		
Crest Length - Spillway (ft)		
Spillway Peak Discharge (cfs)		
Auxiliary Spillway Crest Elev.		
Auxiliary Spill. Head Avail. (ft)		
Type Auxiliary Spillway		
"C" Value - Auxiliary Spill. (ft)		
Crest Length - Auxil. Spill. (ft)		
Auxiliary Spillway Peak Discharge (cfs)		
Combined Spillway Discharge (cfs)		

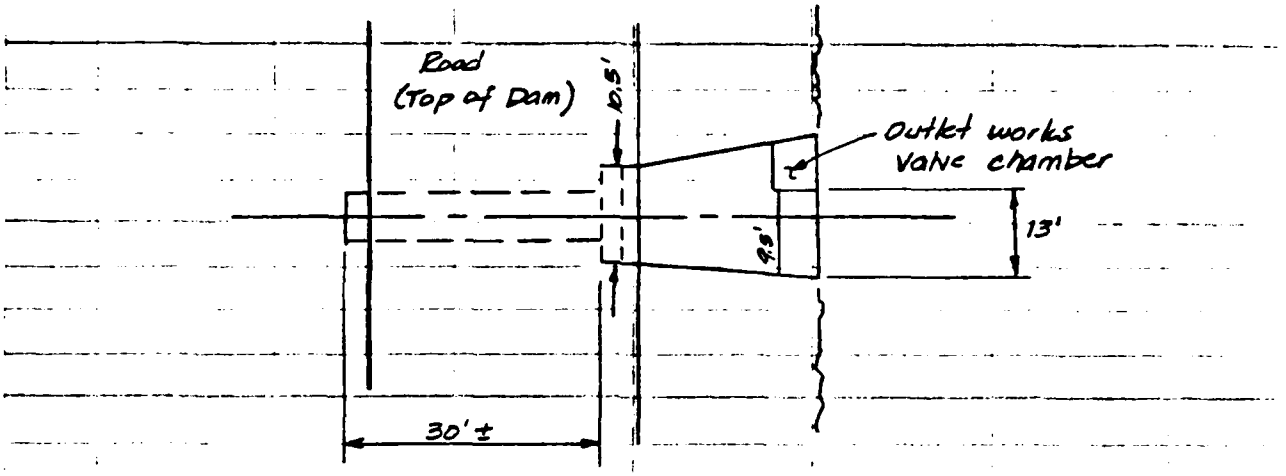
Spillway Rating Curve: FROM SHEET D-8

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)
1337.0			0
1337.5			14
1338.0			40
1338.5			279
1339.0			289
1340.0			310
1341.0			329
1342.0			347
1343.0			364
1346.0			410

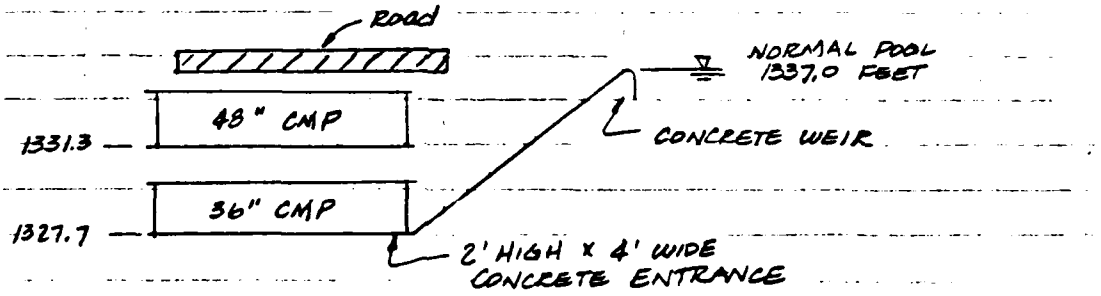
OUTLET WORKS RATING: (USED AS SPILLWAY)	Outlet 1	Outlet 2	Outlet 3
Invert of Outlet	1331.3	1327.7	
Invert of Inlet	—	—	
Type	CMP	CMP	
Diameter (ft) = D	4.0	3.0	
Length (ft) = L	30	30	
Area (sq. ft) = A	12.57	7.07	
N	0.024	0.024	
K Entrance	0.5	0.5	
K Exit	1.0	1.0	
K Friction=$29.1_N{}^2L/R^{4/3}$	0.50	0.74	
Sum of K	2.00	2.24	
$(1/K)^{0.5}$ = C	0.71	0.67	
Maximum Head (ft) = HM	SEE SHEET D-7 & D-8		
$Q = CA\sqrt{2g(HM)}$ (cfs)			
Q Combined (cfs)			

BY _____ DATE _____ SUBJECT LAKE PAUPACKAN DAM SPILLWAY SHEET NO _____ OF _____

CHKD BY _____ DATE _____ JOB NO _____



SPILLWAY PLAN
(NOT TO SCALE)



SPILLWAY PROFILE

Low flow control: $Q = CLH^{1.5}$ L = 13.0 FEET

H = POOL - 1337.0

C = 3.1

High pool control: (see previous sheet)

Note: The above information was taken from the Phase I report for Locklin Pond Dam. The elevations were revised to reflect more accurate information obtained during the inspection.

BY _____ DATE _____ SUBJECT LAKE PAUPACKAN DAM SPILLWAY SHEET NO _____ OF _____
CHKD BY _____ DATE _____ JOB NO _____

From sheet D-6 & D-7:

48" CMP C = 0.71 A = 12.57
Invert = 1331.3

36" CMP C = 0.67 A = 7.07
Invert = 1327.7

(Use effective invert = Invert + D/2)

$Q = CA\sqrt{2gH}$

48" CMP: $Q_4 = 0.71(12.57)\sqrt{64.36(POOL - 1333.3)}$

$Q_4 = 71.6\sqrt{POOL - 1333.3}$

36" CMP: $Q_3 = 0.67(7.07)\sqrt{64.36(POOL - 1329.2)}$

$Q_3 = 38.0\sqrt{POOL - 1329.2}$

Pool Elev.	Q Low flow	Q4+3	QSPILLWAY
1337.0	0	0	0
1337.5	14	–	14
1338.0	40	267	40
1338.5	74	279 *	279
1339.0		289	289
1340.0		310	310
1341.0		329	329
1342.0		347	347
1343.0		364	364
1346.0		410	410

* Flow over outlet works and around sides (switch control)

Note: The above information was taken from the Phase I report for Locklin Pond Dam.

BY _____ DATE _____ SUBJECT LAKE PAUPACKAN DAM SHEET NO _____ OF _____

CHKD BY _____ DATE _____ JOB NO _____

SELECTED COMPUTER OUTPUT

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  01 APR 80
**********************************
```

1	A1				NATIONAL DAM INSPECTION PROGRAM						
2	A2				RALTIMORE DISTRICT CORPS OF ENGINEERS						
3	A3				LAKE PAUPACKAN DAM						
4	B	300	0	15	0	0	0	0	0	-4	0
5	B1	5									
6	J	1	6	1							
7	J1	1.0	0.5	0.4	0.3	0.2	0.1				
8	K	0	1					1			
9	K1	INFLOW TO LAKE PAUPACKAN									
10	M	1	1	2.62		2.62				1	
11	P		21.5	111	123	133	142				
12	T							1.0	0.05		0.14
13	W	1.81	0.45								
14	X	-1.5	-0.05	2.0							
15	K	1	1					1			
16	K1	ROUTE THROUGH LAKE PAUPACKAN DAM									
17	Y				1	0					
18	Y1	1						-1337	-1		
19	Y4	1337	1337.5	1338	1338.5	1339	1340	1341	1342	1343	1346
20	Y5	0	14	40	279	289	310	329	347	364	410
21	SA	0	239	353							
22	SE	1327.4	1337	1346							
23	SS	1337									
24	SD	1338.7									
25	SL	0	330	370	415	460	480	505	530		
26	SV	1339.7	1339	1339.5	1340	1340.5	1341	1341.5	1342		
27	K	99									

D-10

MULTI-RATIO ANALYSIS

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 .50	RATIO 3 .40	RATIO 4 .30	RATIO 5 .20	RATIO 6 .10
HYDROGRAPH AT	1	2.62	1	5393.	2697.	2157.	1618.	1079.	539.
	(	6.79)	(	152.71)(	76.36)(	61.09)(	45.81)(	30.54)(	15.27)(
ROUTED TO	1	2.62	1	4453.	1725.	1179.	656.	284.	73.
	(	6.79)	(	126.09)(	48.86)(	33.39)(	18.59)(	8.05)(	2.06)(

D-11

Summary of Peak Flows

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1337.00	1337.00	1339.70
STORAGE	765.	765.	1188.
OUTFLOW	0.	0.	283.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1341.11	2.41	1847.	4453.	20.75	43.00	0.00
.50	1340.03	1.33	1543.	1725.	16.50	44.00	0.00
.40	1339.72	1.02	1459.	1179.	15.25	44.50	0.00
.30	1339.34	.64	1357.	656.	12.75	45.50	0.00
.20	1338.74	.04	1199.	284.	3.75	46.75	0.00
.10	1338.07	0.00	1027.	73.	0.00	49.25	0.00

D-12

Overtopping Summary

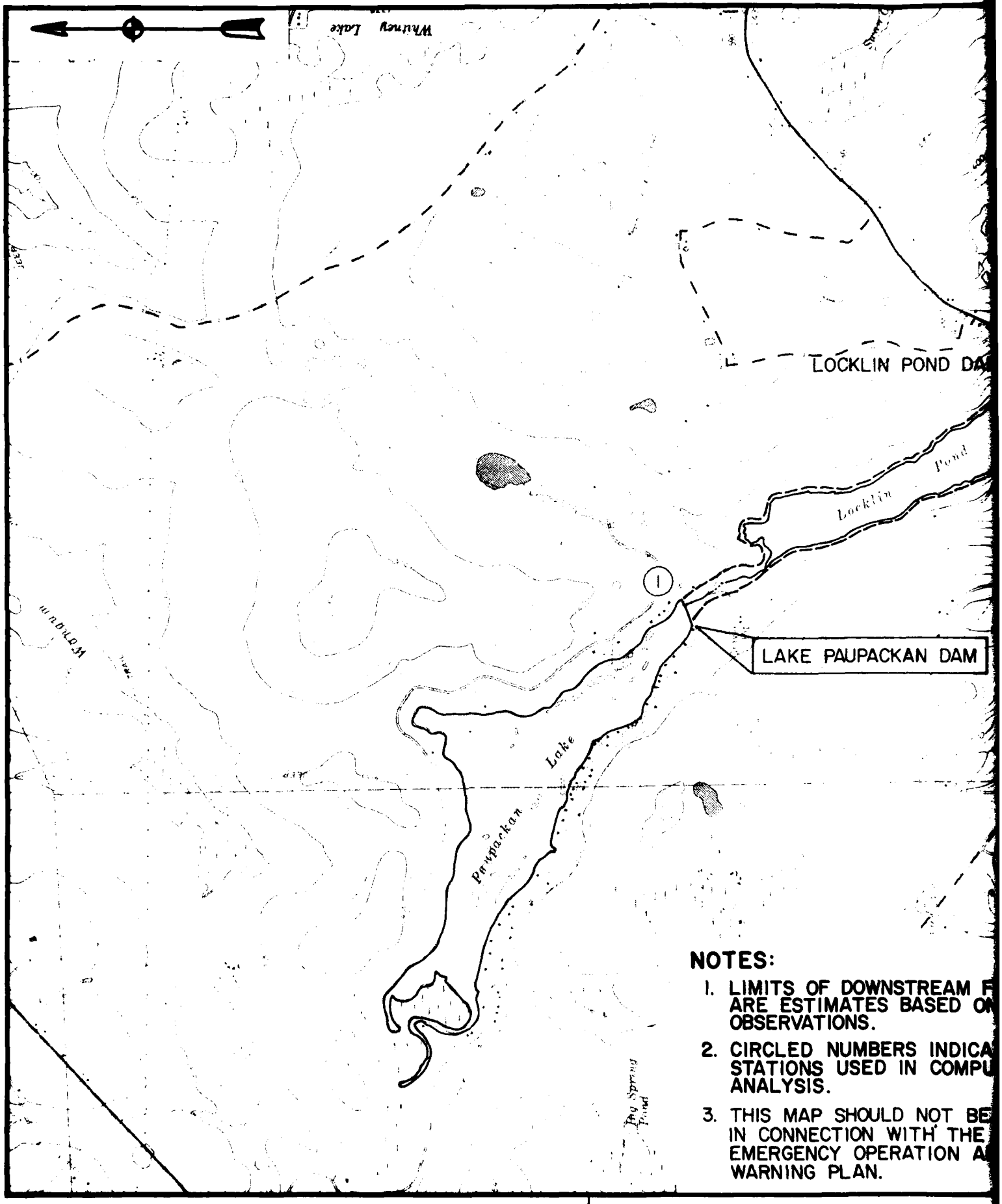
BY _____ DATE _____ SUBJECT LAKE PAUPACKAN DAM SHEET NO. _____ OF _____

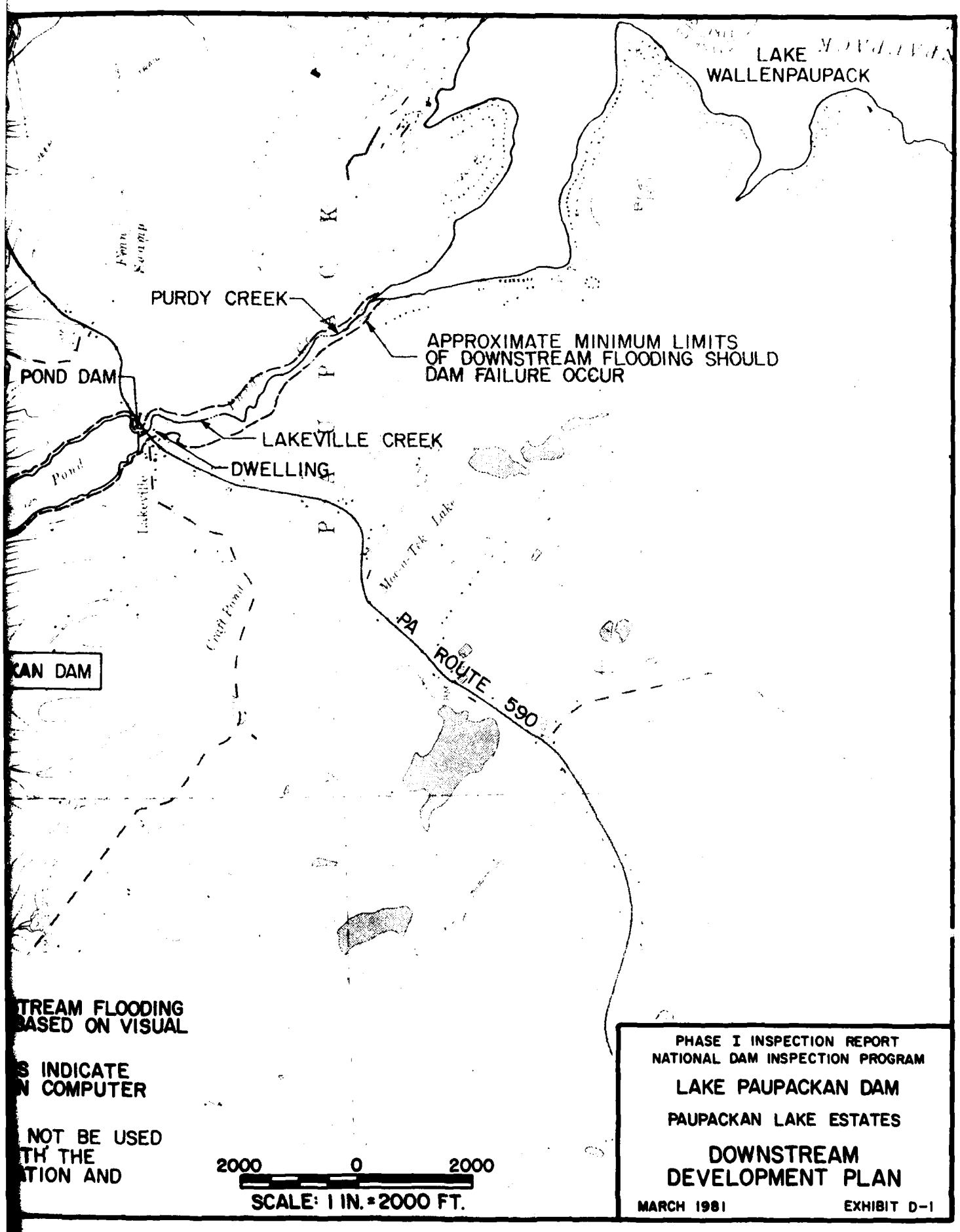
CHKD BY _____ DATE _____ JOB NO. _____

SUMMARY OF PERTINENT RESULTS

Multi-ratio Analysis:

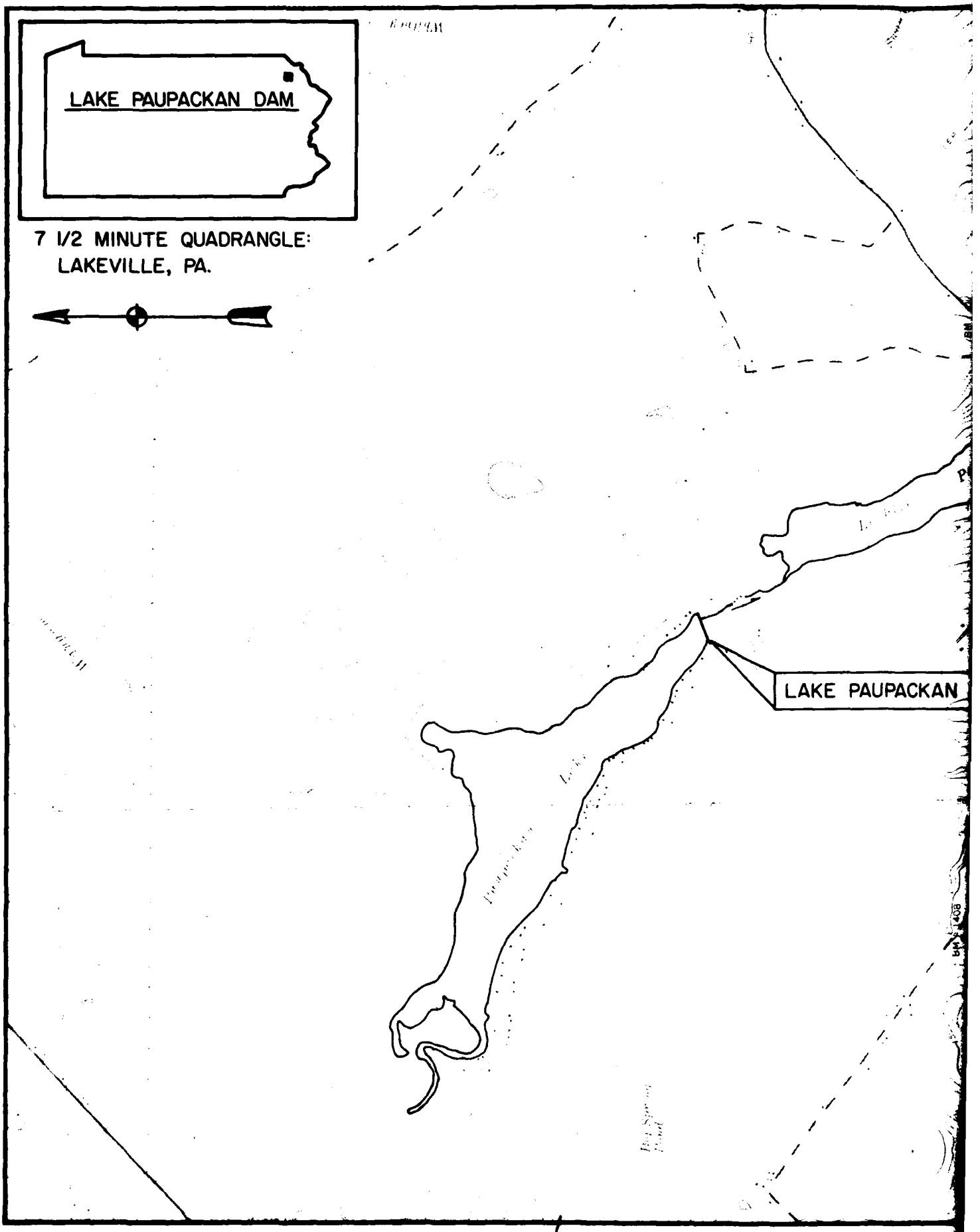
	PMF	1/2 PMF
Rainfall (inches)	24.42	—
Runoff (inches)	22.37	11.19
Peak Inflow (cfs)	5393	2697
Peak Outflow (cfs)	4453	1725
Depth of Overtopping (ft.)	2.41	1.33
Duration of Overtopping (ft.)	20.75	16.50

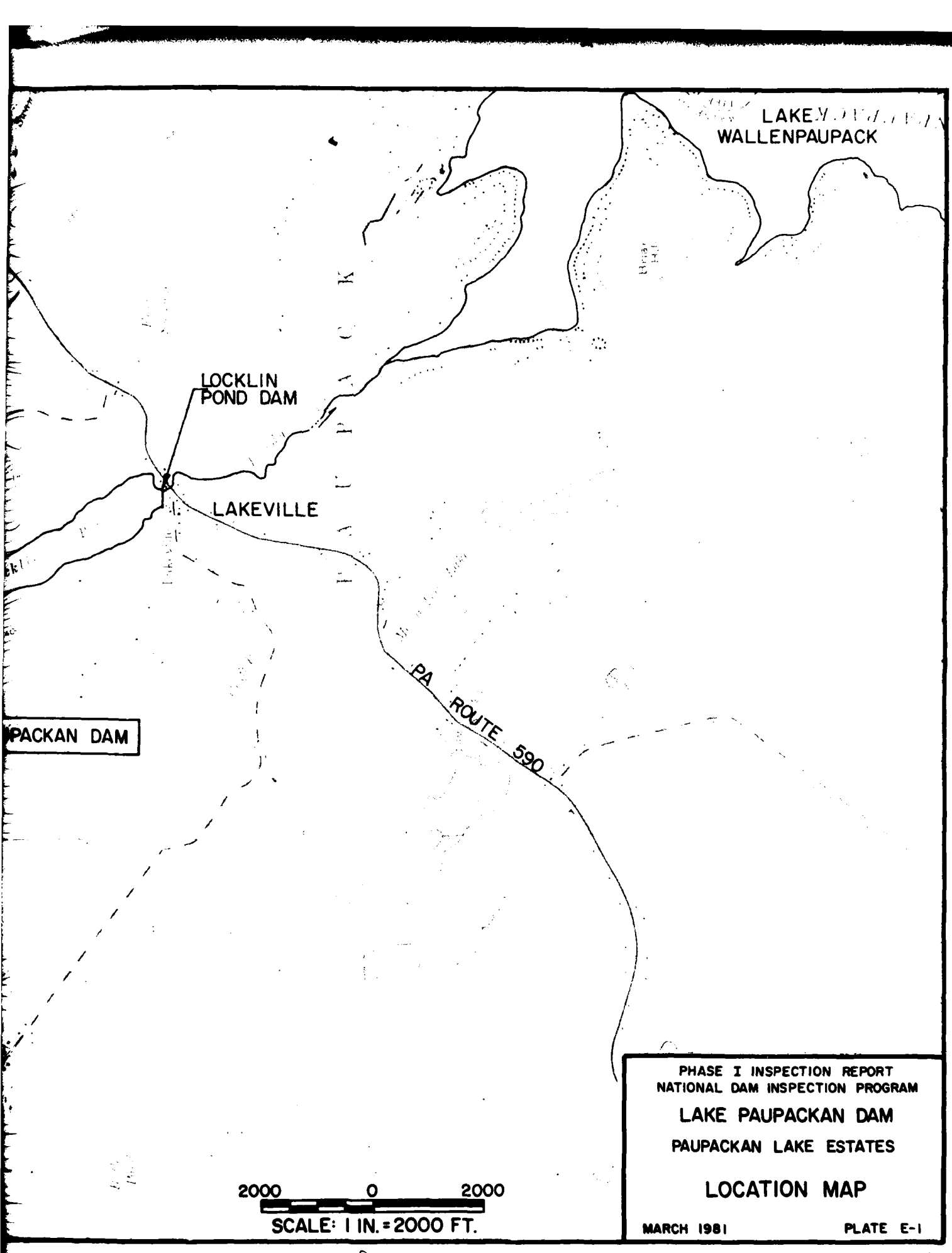

LOCKLIN POND DA
Locklin Pond
LAKE PAUPACKAN DAM
Paupackan Lake
1
NOTES:
1. LIMITS OF DOWNSTREAM F
ARE ESTIMATES BASED O
OBSERVATIONS.
2. CIRCLED NUMBERS INDICA
STATIONS USED IN COMPU
ANALYSIS.
3. THIS MAP SHOULD NOT BE
IN CONNECTION WITH THE
EMERGENCY OPERATION A
WARNING PLAN.


LAKE WALLENPAUPACK
PURDY CREEK
APPROXIMATE MINIMUM LIMITS OF DOWNSTREAM FLOODING SHOULD DAM FAILURE OCCUR
POND DAM
LAKEVILLE CREEK
DWELLING
PA ROUTE 590
TREAM FLOODING
ASED ON VISUAL
S INDICATE
N COMPUTER
NOT BE USED
TH THE
TION AND
2000 0 2000
SCALE: 1 IN. = 2000 FT.
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
LAKE PAUPACKAN DAM
PAUPACKAN LAKE ESTATES
DOWNSTREAM DEVELOPMENT PLAN
MARCH 1981
EXHIBIT D-1

APPENDIX E

PLATES


LAKE PAUPACKAN DAM
7 1/2 MINUTE QUADRANGLE:
LAKEVILLE, PA.
LAKE PAUPACKAN



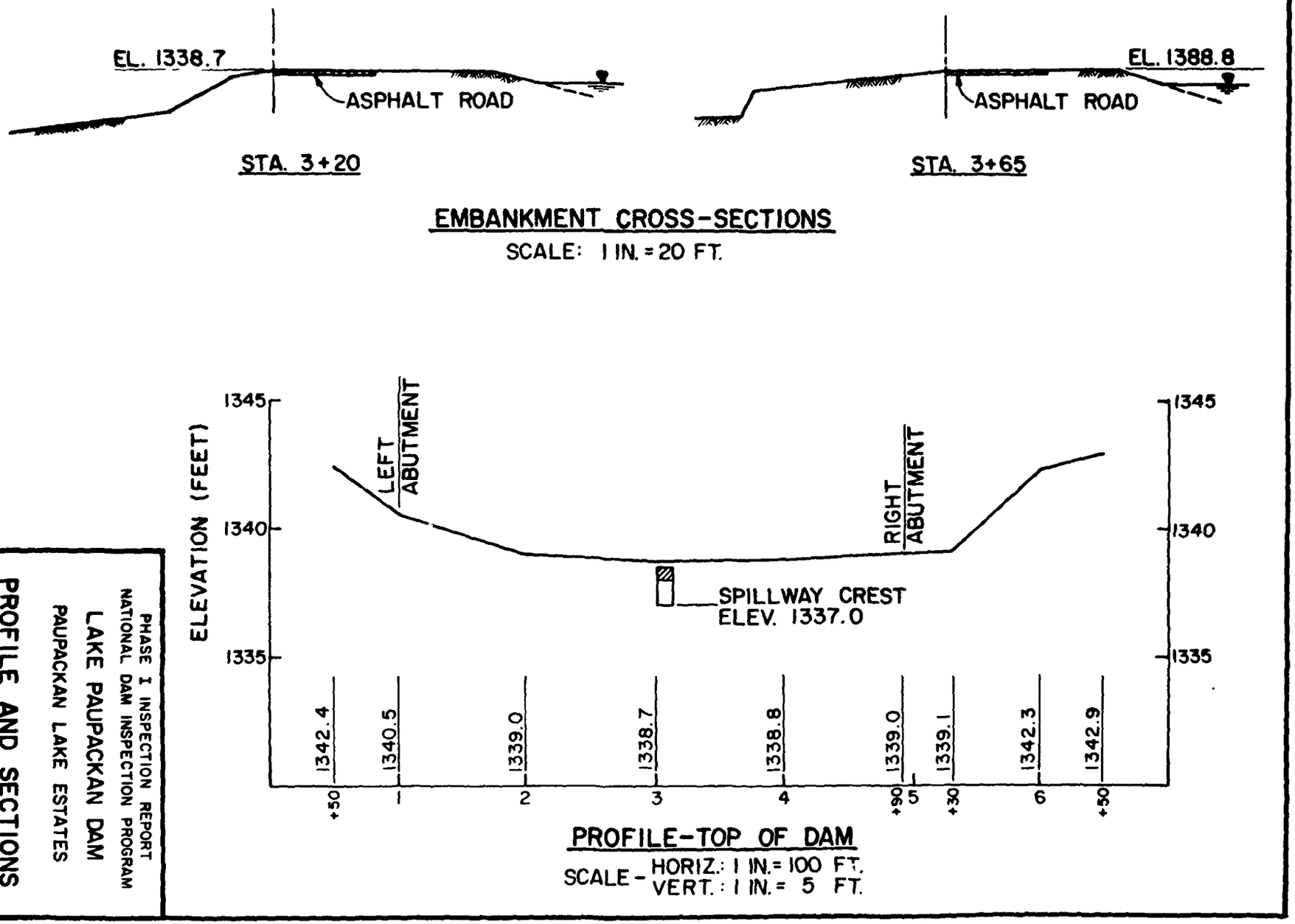
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE PAUPACKAN DAM

PAUPACKAN LAKE ESTATES

LOCATION MAP

MARCH 1981 PLATE E-1



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE PAUPACKAN DAM

PAUPACKAN LAKE ESTATES

PROFILE AND SECTIONS

MARCH 1981

PLATE E-2

APPENDIX F

GEOLOGY

LAKE PAUPACKAN DAM

APPENDIX F

GEOLOGY

Lake Paupackan Dam is located in Wayne County within the Appalachian Plateau Physiographic Province. The most pronounced topographic feature in the area is Camelback Mountain, which is part of the Pocono Plateau Escarpment. The escarpment has a well-defined, southwestward trend from Camelback Mountain; but it is irregular between Camelback Mountain and Mt. Pocono, which lies to the north. Streams east of the escarpment drain directly to the Delaware River, while those to the west drain to the Lehigh River.

The Pocono Plateau Section lies to the west of the escarpment. This area is relatively flat, with local relief seldom exceeding 100 feet. The topography has been greatly influenced by continental glaciation. Many features were created by deposition of glacial materials. The entire plateau lacks well-developed drainage.

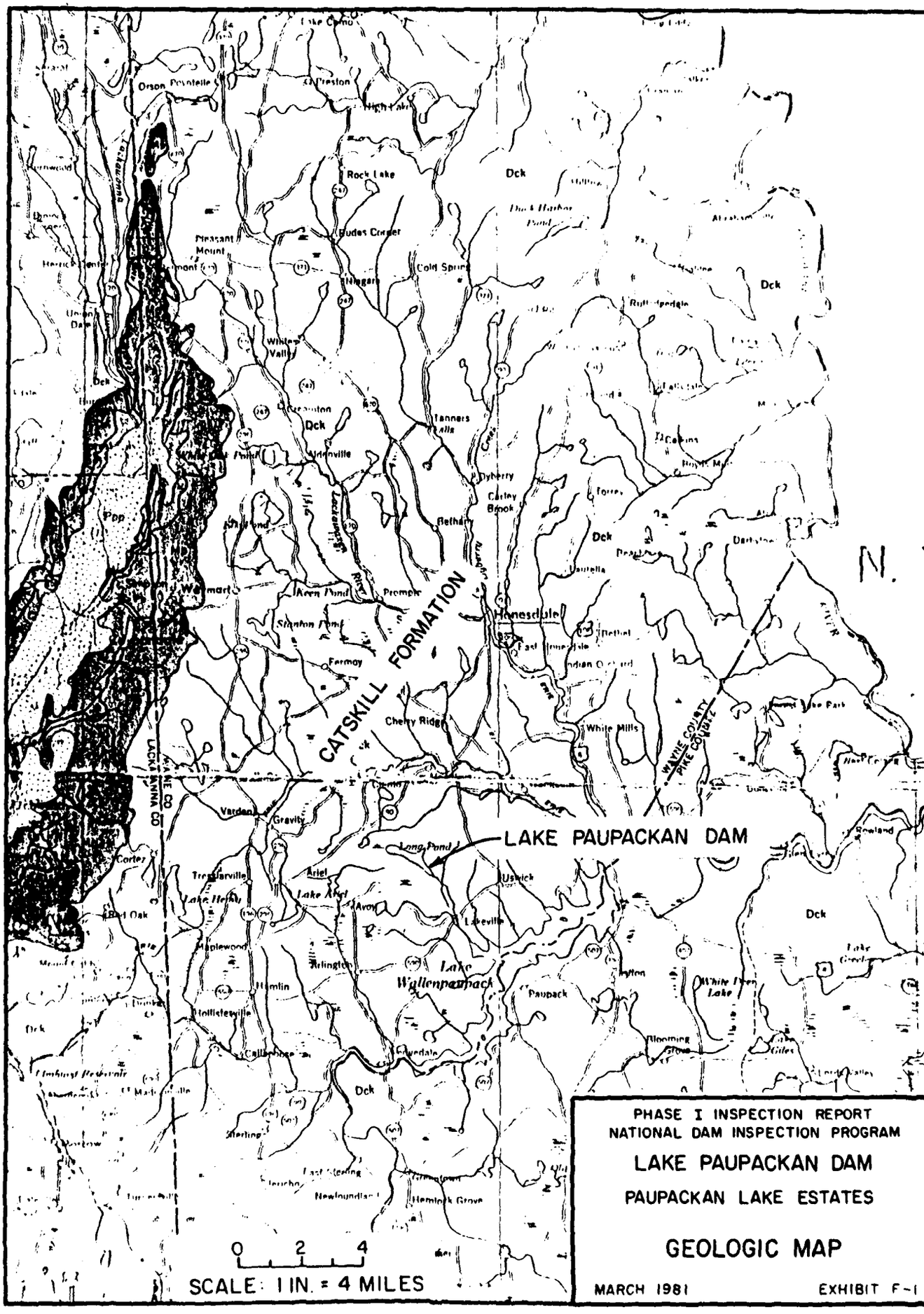
East of the escarpment is the Glaciated Low Plateaus Section of the province. This area is characterized by preglacial erosional topography with locally-thick glacial deposits. Local relief is generally 100 to 300 feet.

Bedrock units of the sections described above are the lithified sediments of offshore marine, marginal marine, deltaic environments, and fluvial environments associated with the Devonian Period. These units include siltstones of the Mahantango Formation, siltstones and shales of the Trimmers Rock Formation, and seven mapped members of the Catskill Formation. These members include sandstones, siltstones, and shales of the Towamensing Member; sandstone, siltstone and shale of the Walcksville Member; sandstones, siltstones and shale of the Beaverdam Run Member; sandstone and shale in the Long Run Member; sandstones and conglomerates in the Packerton Member; sandstones and some conglomerates in the Poplar Gap Member; and sandstones and conglomerates in the Duncannon Member.

Lake Paupackan Dam is underlain by the Catskill Formation. The Catskill Formation is predominantly red to brownish gray shales and sandstone with interbedded siltstones and conglomerates. Sandstones present are thick-bedded, fine- to coarse-grained and exhibit very low primary porosity due to a clay and silica matrix. Effective porosity results from fractures and parting planes.

The rocks are well-indurated and generally are not susceptible to slope failure; however, the presence of well-developed bedding and joint planes will result in some rockfall from vertical and high-angle cut slopes.

Bedrock is entirely overlain by glacial till of Late Wisconsin Age. This till is an unsorted mixture of clay, silt, sand, and gravel. It is moderately cohesive and is generally derived locally from the sandstones of the Catskill Formation. Thickness of the till varies from 5 to 75 feet.



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE PAUPACKAN DAM

PAUPACKAN LAKE ESTATES

GEOLOGIC MAP

MARCH 1981 EXHIBIT F-1